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Parent and Teacher Ratings of Behavioral Executive Functioning for Students With Dyslexia

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Abstract

Research exploring behavioral ratings of executive functioning (EF) for children and adolescents with dyslexia is scarce, which limits researchers, clinicians, educators, and parents from understanding and best supporting these students at home and/or school. Using the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2) rating scale to measure participants' EF behaviors in home and school settings, a primary objective of this study was to examine the EF of Spanish children and adolescents with dyslexia ($n = 78$) and to compare their EF with typically developing (TD) peers ($n = 82$). The study also sought to examine agreements and disagreements among teacher and parent raters. One key finding was that children and adolescents with dyslexia were rated by both parents and teachers as having more frequent cognitive, behavioral, and emotional EF difficulties in home and school compared with TD peers. However, teachers often reported greater severity of impairments than parents did across several EF domains, potentially suggesting a differential pattern of EF difficulties between home and school. Results are discussed in relation to multi-informant assessment practices for EF behaviors (e.g., there may be differential patterns of EF difficulties between home and school) and how the findings have implications for supporting children and adolescents with dyslexia.

Keywords

BRIEF-2, cognitive regulation, dyslexia, executive functioning, parents, teachers

Dyslexia is a specific reading disorder of neurological origin that persists throughout life despite an individual having adequate intelligence, education, and socioeconomic background to learn to read (American Psychiatric Association [APA], 2013). Individuals with dyslexia have difficulties with accurate or fluent word recognition (Shaywitz et al., 2008; Snowling & Hulme, 2012). Compared with students with average to above-average reading skills, accumulated evidence suggests that students with dyslexia can show a range of reading-related (e.g., pseudoword reading, spelling, vocabulary) and cognitive (e.g., rapid naming, verbal, working memory) difficulties (Kudo et al., 2015; Vellutino et al., 2004).

In recent years, a growing body of evidence suggests that children and adolescents with dyslexia may also manifest difficulties with executive functioning (EF). Although there is no universally agreed-upon definition of EF, most conceptualizations include several related but separate skills associated with purposeful, goal-oriented, problem-solving behaviors that support cognitive, emotional, and behavioral regulation (Castellanos et al., 2018; Hofmann et al., 2012; Lezak et al., 2004). Several models of EF have been proposed, and there has been some debate about specific definitions and subcomponents of EF constructs (Burguess et al., 1998; Zelazo et al., 2016). The present study utilizes the model of EF proposed by Gioia et al. (2000, 2015), which attempts to incorporate the emotional, behavioral, and cognitive skills that are broadly described as executive abilities.

The first version of this model attempted to obtain more detailed information about EF subprocesses. Using the Behavior Rating Inventory of Executive Function (BRIEF) the original model included eight scales that clustered together in a behavioral regulation and a metacognitive factor (Gioia et al., 2000). However, a later reorganization of the model into nine subscales found evidence of three underlying EF factors or domains: a cognitive regulation factor, a behavioral regulation factor, and an emotional regulation factor (Gioia et al., 2002a). Importantly, this

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revision and reorganization of the BRIEF contained no new items, which allowed for direct comparison of scores between versions. In the Gioia et al. (2002a) study, the item content of the Monitor scale was re-examined and hypothesized to reflect two distinct dimensions (i.e., one's ability to monitor task-related activities or monitor personal activities) that were associated differently with the cognitive regulation and behavioral regulation factors, respectively. Multiple subsequent studies using exploratory and/or confirmatory factor analysis (Byerley & Donders, 2013; Egeland & Fallmyr, 2010; Gioia et al., 2015; Peters et al., 2012) supported the multidimensional view of Gioia and colleagues' (2002a) model of EF as well as the cognitive, behavioral, and emotional domains.

General characteristics of the three domains described within this model are as follows. The cognitive domain of EF refers to the degree of difficulty a person has in trying to control or manage their cognitive processes and problem solving effectively. This cognitive domain includes processes such as indentifying and planning to reach future goals, initiating efforts to implement plans, monitoring progress toward goal achievement, and utilizing working memory. The behavioral domain of EF refers to the degree of difficulty a person has when regulating and supervising their behaviors effectively; it includes the ability to inhibit behavioral responses not relevant for goal achievement and to monitor one's own behavior as well as those of others to appropriately gauge behavioral responses. The emotional domain of EF reflects the degree of difficulty a person has when regulating emotional responses, especially in response to changing situations; it includes skills related to appropriately modulating emotional responses as well as flexibility when shifting from situation to situation or from task to task.

By distinguishing these three domains of EF and measuring it with, for example, the BRIEF rating scale, this allows for clearer assessment of an individual's strengths and weaknesses in EF—and such an assessment has direct implications for developing the most relevant interventions or supports for an individual who has difficulty in one or more domains. For example, if a child with a neurodevelopmental disorder is struggling specifically with EF skills related to cognitive regulation, but the child appears to have EF skills related to behavioral and emotional regulation that are generally consistent with same-age peers, the child's parent(s)/caregiver(s), teachers, and/or psychologist can plan for intervention and follow-up observations using this knowledge about relative domain-specific strengths or challenges in EF. Ultimately, this type of "targeted" intervention, as well as follow-up observation and evaluation, is a lynchpin of any helping profession because services are provided directly to the particular areas of need. Moreover, as we will discuss in more detail later in this article, assessment of specific EF domains can also elucidate relative strengths or weaknesses in specific settings (e.g., at home vs. in school), which also helps to understand an individual's relative strengths, needs, and setting-specific areas that could be targeted for support.

Evaluating EF for Students With Dyslexia

Although there have been different studies that have used rating scales of EF for individuals with attention-deficit hyperactivity disorder (ADHD; for example, Jacobson et al., 2016), math disabilities (Holm et al., 2018), specific language impairment (Wittke et al., 2013), reading comprehension difficulties (Locascio et al., 2010), and other neurodevelopmental disorders and psychopathologies (see Gioia et al., 2002b; Snyder et al., 2015; Wochos et al., 2014), there are only four known studies that have used a behavioral rating scale to examine EF in students with dyslexia. For instance, Gioia et al. (2002b) used the parent version of the BRIEF with 34 English-speaking children with reading disabilities and found EF deficits in cognitive regulation (i.e., working memory, planning–organization), and in behavior regulation (i.e., inhibition scales), with 62% (working memory), 47% (planning–organization), and 29% (inhibition) of these children meeting the clinical significance range on those scales.

Locascio et al. (2010) administered the parent version of the BRIEF to parents of 44 English-speaking children from 10 to 14 years old with word recognition deficits. They found that parents whose children had poor word recognition skills rated their child as having significantly lower levels of EF than children with reading comprehension problems and controls. However, only global executive composite (GEC) scores were reported in their study, and this overall summary score, collapsed across cognitive, behavioral, and emotional facets of EF, does not reveal the specific skills of EF that parents of children with dyslexia often rate as problematic. As noted previously, understanding domain-specific strengths and weaknesses has important implications for comprehensively understanding an individual's EF skills and developing targeted supports when weaknesses are significant.

Similar to findings of Gioia and colleagues (2002b), Schöfl et al. (2014) found that 17 German-speaking children with dyslexia (compared with a control group without dyslexia) were rated by parents as having more cognitive regulation difficulties with working memory and planning–organization. Most recently, Smith-Spark et al. (2016) showed that 31 English-speaking adults with dyslexia self-reported more frequent EF problems, with these difficulties centering on metacognitive processes (working memory, planning, task monitoring, and organization), rather than on the regulation of emotion and behavior. However, although statistical significance was not reached, adults with dyslexia had lower EF in terms of regulating emotion and behavior.

Overall, these earlier studies of EF in students with dyslexia show that, in a home context, parents rated children with dyslexia as having EF difficulties in different domains. Interestingly, no past studies have included schoolteachers to report on the EF of children with dyslexia. This is important because the domains of EF (i.e., cognitive, behavioral, and emotional) are distinct and its multidimensional nature indicates that specific EF difficulties may appear in singular or multiple domains across differing contexts and setting-specific demands (Goldberg & Podell, 2000). For example, home and school settings differ in cognitive demands as well as in norms for behavioral and emotional expression (Allan & Gilbert, 2002). Thus, it is necessary to evaluate EF in different contexts (e.g., home and school) to understand how those with dyslexia use EF in response to different setting-specific demands. Such an evaluation allows for a more comprehensive assessment and the ability to examine possible agreements and disagreements between informants (e.g., parents and teachers).

Evaluating Agreements and Disagreements Between Different Rating Scale Informants

Disagreements between informants are most pronounced when they observe children in different settings and when they play different roles in children's lives, such as parents and teachers (e.g., Achenbach, 2017; De Los Reyes & Kazdin, 2005). For instance, some studies showed low-to-moderate correlations across behavior rating scales (e.g., ADHD, problem behavior) taken from multiple information sources of the same symptoms (Achenbach et al., 1987; De Los Reyes et al., 2015; Miranda et al., 2008). However, not all studies fit this pattern. For example, using the BRIEF, Gioia et al. (2015, 2017) found moderate and high correlations for a normative sample. Inconsistent results across studies might come from the use of different types of questionnaires across studies and/or from the inclusion of varying age groups, who might behave in different ways within the various domains that may be assessed (e.g., internalizing behavior, behaviors associated with ADHD, EF, socio-emotional competence).

A prevailing notion in clinical assessment is that informant discrepancies (e.g., from parents and teachers) largely reflect measurement error or informant biases, but accumulated evidence does not support this as the primary or most parsimonious explanation (De Los Reyes et al., 2013). Rather, informant disagreements may reflect true situation-related variation in behavior and/or differences in raters' knowledge and experiences (Achenbach, 2011, 2017; De Los Reyes & Kazdin, 2004, 2005). For example, parents may base their ratings on how their children behave at home and respond to common home-based directives, such as "go to bed," "clean your room," or "complete your chores." Teachers base their ratings on how the child behaves at school and responds to school-based responsibilities (e.g., interacting with peers in class, staying on-task during classroom instruction). In addition, parents likely base their ratings on a very limited set of experiences between themselves and their child(ren), whereas teachers may frequently interact with 20 or more students each year and thus have relatively limited time with any one child as well as a broader set of age-specific comparisons. It is also more likely that teachers' ratings will be based on a relatively more structured setting (De Los Reyes et al., 2009). These situational variations may result in disagreements between parent and teacher ratings. Cross-informant disagreement (CID) therefore represents, in part, true variation among children in how their behavior is bound to a given context (e.g., home and school). Thus, disagreements across informants' ratings of children's behavior in different contexts likely represent not only variation but also a meaningful heterogeneity in clinical patterns.

Purpose of the Present Study and Research Questions

Although a small number of prior studies have sought to measure EF in children and adolescents with dyslexia, this research base is still quite limited. For instance, no prior studies using rating scales of EF in youth with dyslexia have used multiple informants (e.g., parents and teachers), yet the assessment of multiple informants is critical because EF skills are required in multiple contexts, such as being able to inhibit inappropriate behavior or remember a sequence of tasks (Reynolds & Horton, 2008; Zelazo et al., 2016). In addition, only two past studies compared domains of EF ratings between children or adolescents with and without dyslexia—and both of those studies had a relatively small sample of participants with dyslexia ($n = 17$ and 34).

To address these notable gaps in the existing literature and, in general, to advance an empirical understanding about EF for children and adolescents with dyslexia, our study had two research questions.

> **Research Question 1 (RQ1):** What are parents' and teachers' perceptions of EF for youth with dyslexia compared with their typically developing (TD) peers?
> **Research Question 2 (RQ2):** In what ways are there agreements and disagreements between informants' ratings of EF in two contexts (i.e., home and school)?

The "Data Analysis" section of this article explains how each research question was addressed and explains how we used three research-informed and complimentary approaches to answering RQ2.

Method

Participants

The final sample for this study included 160 Spanish-speaking children and adolescents. Participants came from 74 schools in the Valencian Community (Spain), gathered from 268 referrals to this multiyear investigation. All participants were Caucasian and spoke Spanish as their primary language. Table 1 shows the demographic characteristics of the participants. As shown, they ranged from 9 to 15 years old (*M* age = 10 years, 8 months; *SD* = 1 year, 4 months), with 88 males and 72 females representing two separate groups for the purpose of this study: (a) the dyslexia group (DG), consisting of 78 students with dyslexia (*M* age=11 years, 1 month; 40 males and 38 females), and (b) the TD control group, consisting of 82 students (*M* age = 10 years, 8 months; 48 males and 34 females) who did not present with characteristics associated with dyslexia.

Preliminary selection of potentially eligible participants was consistent with several past studies (e.g., Begeny et al., 2011; Pereira-Laird et al., 1999; Soriano-Ferrer et al., 2011; Soriano-Ferrer & Miranda, 2010), such that potential DG participants in the present study were recommended by teachers based on students' low reading achievement in the classroom. The actual presence of dyslexia for DG participants was then determined by using the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; APA, 2013) criteria specified for identifying students with a specific learning disability: (a) scores of 80 or above on an intelligence test (Cattell & Cattell, 2006), to exclude students with cognitive impairments; (b) no evidence or history of neurological damage, significant economic disadvantage, emotional disturbance, hearing or vision abnormalities, or any other major handicapping condition; and (c) a reading achievement score at or below the 25th percentile on the word-reading and/or pseudoword-reading skill subtests from the Standardized Reading Skills Battery (PROLEC-R, Cuetos et al., 2002; PROLEC-SE, Ramos & Cuetos, 2003). Thirty-eight children and adolescents with dyslexia (48.7%) attended special education classes (i.e., resource rooms) 3 hr per week in their respective schools, as stipulated in the current regulations in Spain for students with learning disabilities. The children in the TD control group only attended regular classrooms and did not receive educational services outside of the regular classroom. All participants in the TD group met the following criteria: (a) average or better academic performance in all areas according to a teacher's report, (b) scores of 80 or above on intelligence, and (c) a reading achievement score at or above the 50th percentile on the word-reading and pseudoword-reading skill subtests from the Standardized Reading Skills Battery. In some cases, information on the academic and developmental history of the children was obtained from the school's psycho-educational support services, and in other cases, this information was obtained from the student's family.

From the 268 referrals to this study, 108 students were excluded for different reasons: 65 met criteria for ADHD, 10 had an intelligence test score < 80, five had a maternal language different from Spanish, and three had vision problems that had not been corrected. Finally, 25 participants (9.3% of the total sample) who would otherwise have been included in the study could not be included due to incomplete data (i.e., parent, teacher, and child assessments were not completed).

Measures

Demographic information questionnaire. Caregivers (henceforth referred to as *parents*) supplied information about their sex, level of education, occupation (based on International Labour Organization, 2012), and marital status. They also responded to items about their child's past and current schooling (e.g., number of grade retentions, whether they received homework help).

Factor "g" intelligence test (Scale 2, Form A). This test (Cattell & Cattell, 2006) measures general mental capacity without the interference of verbal stimuli. The test requires the search for relationships between abstract shapes and figures. The reliability of the Spanish adaptation of this intelligence test is .86. In the current sample, the Cronbach's alpha was .79.

Standardized Reading Skills Battery. Word and pseudoword-reading skills were measured with the PROLEC-R and PROLEC-SE. Word reading requires the correct identification of 40 words that vary greatly in frequency, length, and spelling structure (CCV, CVV, CVC, CCVC, CVVC, and VC, where C = consonant and V = vowel), and pseudoword reading consists of pronouncing 40 pseudowords, constructed by changing or adding one or two letters to each of the 40 words on the reading test. In word and pseudoword reading, task completion is timed. Two combined scores of fluency are obtained, one based on word-reading fluency and the other on pseudoword-reading fluency. In both cases, the child's score consists of an accuracy score divided by the reading speed, measured as the time taken to complete the task, and then multiplied by 100. This reading battery has been found to have adequate internal consistency (Cronbach's $\alpha = .74$).

BRIEF-2. We used the Spanish version of the BRIEF-2 (Gioia et al., 2017), which is completed by parents or teachers to reflect the frequency with which a child aged 5 to 18 years exhibits specific behaviors. The parent and teacher

Table 1. Descriptive Data According to Participants in the DG and the TD Group.

	DG (n = 78)		TD group (n = 82)		Statistics		
Variable	*M*	*SD*	*M*	*SD*	$F(1, 158)$	p	η^2
Age	11.01	1.40	10.8	1.54	n.s.	n.s.	n.s.
IQ	104.3	12.47	105.2	15.58	n.s.	n.s.	n.s.
Word-reading accuracy	34.41	4.91	39.74	0.52	95.345	.001	.37
Word-reading speed	75.87	30.26	40.73	13.95	90.558	.001	.36
Word-reading fluency	51.95	18.30	109.04	36.39	154.695	.001	.47
Pseudoword-reading accuracy	28.82	6.78	39.01	1.51	176.051	.001	.52
Pseudoword-reading speed	92.05	31.14	52.73	14.31	106.980	.001	.40
Pseudoword-reading fluency	34.93	14.25	79.58	21.78	232.853	.001	.46
	n	%	*n*	%	$\chi_{(1)}^2$	p	
Sex							
Female	38	48.7	34	41.5	n.s.	n.s.	
Male	40	51.3	48	58.5			
Student Academic Information							
Grade retention	8	10.2	0	0	9.344	.002	
Resource room	38	48.7	0	0	55.668	.001	
Homework help	68	87.2	38	46.3	29.829	.001	
Father's educational level							
Elementary	25	32.1	45	54.8	8.486	.01	
Medium	35	44.8	25	30.5			
High	18	23.1	12	14.6			
Mother's educational level							
Elementary	24	30.7	39	47.6	9.825	.01	
Medium	28	35.9	32	39			
High	26	33.4	11	13.4			
Father's occupation[a]							
Without a paid job	0	0	5	6.1	10.370	.05	
Skill Level 1	4	5.1	12	14.6			
Skill Level 2	56	71.8	52	64.6			
Skill Level 3	12	15.4	7	8.5			
Skill Level 4	6	7.7	6	6.1			
Mother's occupation[a]							
Without a paid job	18	23.1	21	25.6	n.s.	n.s.	
Skill Level 1	30	38.5	40	48.8			
Skill Level 2	24	30.8	11	13.4			
Skill Level 3	6	7.7	10	12.2			
Skill Level 4	0	0	0	0			

Note. DG = dyslexia group; TD = typically developing; n.s. = not statistically significant.
[a]Based on the International Labour Organization (2012).

forms each contain 63 items that yield nine non-overlapping but correlated clinical scales. By circling "never," "sometimes," or "often," the raters indicate whether the child has experienced problems during the past 6 months with a given behavior described in a particular item. The BRIEF-2 also provides three summary indices: the Behavioral Regulation Index (BRI), Emotional Regulation Index (ERI), and Cognitive Regulation Index (CRI). The two-scale BRI includes (a) Inhibition (eight items), which measures the ability to control impulses, and (b) Self-Monitor (four items), which measures the ability to keep track of the effect of one's own behavior on others. The two-scale ERI includes (a) Shift (eight items), which measures the ability to transfer between tasks and mind-sets, and (b) Emotional Control (eight items), which measures the ability to modulate emotional responses. The five-scale CRI includes (a) Initiate (five items), which measures the ability to begin a task or activity independently; (b) Working Memory (eight items), which measures the ability to hold relevant information in the mind for the purpose of completing a task; (c)

Planning–Organization (eight items), which measures the ability to plan ahead and organize for future events and goals; (d) Task Monitoring (five items), which measures the ability to check work and assess performance during or after finishing a task to ensure attainment of goal; and (e) Organization of Materials (six items), which measures the ability to keep the workspace and materials organized.

Across these three indices (BRI, ERI, and CRI) and the nine subscales just listed, a global score (GEC) is comprised by the nine subscales. On all the scales, higher scores indicate more difficulties in that area. The BRIEF-2 provides *T*-scores on all scales and indices, and its reliability and validity have been widely demonstrated (Gioia et al., 2017). In the Spanish version, Cronbach's alphas range from .81 to .94 for the parent version and from .86 to 95 for the teacher version, across ages. In the current sample, Cronbach's alpha ranged from .80 to .91 for the parent version and from .83 to .94 for the teacher version.

Procedure

The study respected all principles outlined in the current legislation on clinical investigations and was approved by the Research Ethics Committee of the University of Valencia, which is regulated by the Ethical Principles for Medical Research Involving Human Subjects (Declaration of Helsinki, 1964 in World Medical Association, 2013). For example, oral permission from the children and parents' informed consent was obtained prior to commencing any study procedures.

Recruitment of participants for this study occurred by (a) contacting relevant parent associations (e.g., associations for parents of children with dyslexia) and sharing study participation information with members, and (b) contacting school psychologists from different schools throughout the region to share the same study participation information and asking them to share the information with families of children attending the school. For the DG participants, school psychologists asked teachers to recommend children from their classrooms who had low reading achievement. From that list, the psychologists informed the families of those children about the study. Participants in the TD group were recruited from the same schools of participants from the DG. School psychologists first provided general information about the study to the families of children attending the participating schools, indicating that participation required children to have average or above-average academic performance. For all parents and children who showed interest in participating in the research, the research team then provided them with more detailed information about participating in the study.

After receiving proper consent, an experienced and licensed clinical psychologist (the third author of this article) administered the aforementioned reading skills battery and cognitive assessment according to the respective standardized protocols. These measures were administered in random order and in a room free from noise and distractions. Test sessions varied in length depending on the participant being assessed. Children and adolescents received a gift (e.g., pens, colored pencils, cases, USB memory stick) for participating.

As noted previously, recruitment procedures generated a pool of 268 potentially eligible child and adolescent participants. Using the inclusion criteria described in the "Participants" section, the research team examined all screening data to determine eligible participants for the study. Of those eligible, a parent and teacher of each participant was asked to complete the respective BRIEF-2 rating scale at his or her convenience and either return it in a sealed envelope during the student participant's second assessment session, return it via post to the third author in a self-addressed stamped envelope, or send it by email to the third author. Each teacher spent considerable time with the student participant per day (i.e., was the classroom teacher for students in primary school or taught the student in at least two different classes for students in secondary school) and knew the student well for 6 or more months, as recommended in the BRIEF-2 administration manual. As compensation, families and schools were given a report about the participants' performance in the different domains analyzed.

Data Analysis

First, descriptive analysis was used to describe the sample (see Table 1). To analyze data related to RQ1 of our study, a multivariate analysis of covariance (MANCOVA) was computed to compare parents' and teachers' perceptions of EF in children and adolescents with dyslexia compared with their TD peers. A MANCOVA was used due to (a) differences in parental educational level and occupations of fathers between groups (see "Sample Description" subsection under the "Results" section), and (b) the role of several socioeconomic variables (e.g., parental education) in EF outcomes (e.g., Deater-Deckard et al., 2012; Tillman & Granvald, 2015). Thus, for these analyses, fathers' and mothers' educational level and fathers' occupations were included as covariates (based on the dependent variables), and the group of origin (DG and TD) was the grouping factor. Next, a between-groups analysis of covariance (ANCOVA) was conducted for each measure. To control for multiple comparisons, a Bonferroni correction (an alpha level of $p < .001$) was used. We report effect sizes using the partial eta squared (η_p^2) statistic, with values between 0.01 and 0.10 considered small effect sizes, values between 0.10 and 0.49 considered medium, and values above 0.50 considered large effect sizes.

Regarding analyses for RQ2, the current literature has mixed recommendations and practices regarding the optimal method for evaluating agreements and disagreements between raters (Achenbach, 2011, 2017; De Los Reyes & Kazdin, 2004, 2005). De Los Reyes and Kazdin (2004) pointed out that the mathematical properties of the different measures of informant agreements and disagreements can lead to different conclusions and that these measures are not interchangeable. For this reason, to show a more comprehensive interpretation of the agreements and disagreements of parents' and teachers' ratings of specific impairments in singular or multiple domains of EF across contexts, we used three complementary approaches that have been recommended to assess agreements and disagreements between raters (e.g., McConaughy & Ritter, 2002; Stewart et al., 2017; Teglasi et al., 2017).

Analyses with correlation coefficients. The first method we used to assess agreement between parent and teacher ratings on each of the BRIEF-2 scales was the calculation of Pearson's correlation coefficients. We used this approach to analysis in three ways: across all participants (DG and TD participants), only for the DG, and then only for the TD group.

Analyses with CID scores. As a second method, we computed the CID score by subtracting parents' BRIEF-2 *T*-scores from teachers' *T*-scores for each participant. Positive scores indicate that teachers reported more difficulties than parents did, whereas a negative score means that parents reported more impairment than teachers. We then performed a MANCOVA with parental educational level and fathers' occupations as covariates, based on the dependent variables, with the group of origin (DG and TD) as the grouping factor. Next, a between-groups ANCOVA was conducted for each measure.

Analyses of clinically elevated scores for DG participants. In our third method, we computed the percentage of DG participants who obtained scores in the clinically elevated range. To do this, dichotomous variables were created to analyze clinically significant impairments of DG participants. Each BRIEF-2 subscale was coded as $T \leq 64 = 0$ and $T \geq 65 = 1$. Thus, as recommended by De Los Reyes and Kazdin (2004, 2005), we account for the percentage of children with clinical elevations identified by parents only, by teachers only, by both parents and teachers, and those who were not identified as impaired by either parent or teacher. To evaluate the possible differences between raters (parent vs. teacher) of clinical elevations for DG participants, we used chi-square analyses. Collectively, each of our three approaches to analyses are supported by past research (e.g., De Los Reyes & Kazdin, 2004; McConaughy & Ritter, 2002; Stewart et al., 2017; Teglasi et al., 2017), and by using each of them, we can more comprehensively evaluate our second research question.

Results

Sample Description

There were no differences between the DG and the TD control group on age, the measure of intelligence, and sex. As would be expected, there were significant differences between the groups in word-reading accuracy, word-reading speed, word-reading fluency, pseudoword-reading accuracy, pseudoword-reading speed, and pseudoword-reading fluency, each with large effect sizes. Likewise, participants in the DG had more grade retentions, such that 10.2% of the DG had been retained and 0% of TD group had been retained. Statistically significant differences were also found on other relevant variables that differentiated the two groups. Specifically, 48.7% (DG) versus 0% (TD) attended the school's resource room, and 87.2% of the DG compared with 46.3% of TD group needed help with homework. Means, standard deviations, and statistics of these measures are in Table 1.

In both groups, parent instruments (e.g., BRIEF-2, demographic questionnaire) were filled mainly by mothers (89.7% for DG and 92.6% for TD control group). Both parents completed about 7% in each group (7.7% in DG and 7.4% in TD group) and less than 2.5% of instruments were completed only by fathers (2.5% in DG and 0% in TD group). In addition, most of the parents were married or living together (96.1% for DG and 95.1% for TD control group). Regarding educational level, both the fathers and mothers of the TD group had lower educational levels than the fathers and mothers of the DG. Finally, in relation to occupations, most of the fathers had a paid job in both groups, whereas around 20% of the mothers of both groups did not have a paid job. Occupations of fathers and mothers were distributed into occupations with four levels of skills (see Table 1). There were only significant differences in the fathers' occupations, as the occupations of the fathers of the TD group were less skilled in general. As noted previously, fathers' and mothers' educational level and fathers' occupations were used as covariates in subsequent analyses.

In both groups, teachers mainly identified as female (84.6% for the DG and 82.9% for the TD control group). Teachers' age from the DG ranged from 26 to 61 years old ($M = 39$ years, 7 months; $SD = 9$ years, 8 months), and in the TD group, ages ranged from 25 to 63 years old (M age $= 37$ years, 5 months; $SD = 7$ years, 5 months). In addition, most of the teachers had between 10 and 20 years of teaching experience (56.4% for DG and 58.5% for TD control group) and around 30% in both groups had more than 20 years of teaching experience (30.7% for DG and 32.9% for

TD control group). Approximately 10% of teachers of both groups had less than 10 years of teaching experience (12.8% for DG and 8.5% for TD control group).

Parent and Teacher Reports of EF (RQ1)

In relation to parent ratings, the MANCOVA performed with fathers' and mothers' educational level and fathers' occupations as covariates showed significant main effects by group, Wilks's Lambda (Λ) = .430, $F(13, 143) = 14.602$, $p < .001$, $\eta_p^2 = .57$, with a large effect size. ANCOVA showed that, compared with parents of participants in the TD group, parents rated children in the DG with significantly higher scores on inhibition with a medium effect size, and Self-Monitor, the BRI, Emotional Control, and the ERI with a small effect size in all the cases. With regard to the subscales included in the CRI, the parents also rated significantly more difficulties on Initiation, Working Memory, Planning–Organization, Task Monitoring, Organization of materials, the CRI, and the GEC score, all with a medium effect size (see Table 2).

With respect to teachers' reports, the MANCOVA performed with fathers' and mothers' educational level and fathers' occupations as covariates showed significant main effects by group, Wilks's Lambda (Λ) = .383, $F(13, 143) = 17{,}726$, $p < .001$, $\eta_p^2 = .61$, with a large effect size. ANCOVAs showed that teachers rated children in the DG as having significantly more executive function difficulties than their TD peers on Self-Monitor, the BRI, Shifting, Emotional Control, and the ERI, all with small to medium effect sizes. In addition, teachers gave children and adolescents in the DG higher scores than their TD peers on Initiation, Working Memory, Planning–Organization, Task Monitoring, Organization of Materials, the CRI, and the GEC, with medium to large effect sizes (see statistics in Table 2).

Agreements and Disagreements Among Parent and Teacher Ratings of EF (RQ2)

The first method employed to assess the agreement between raters was the calculation of Pearson's correlation coefficients across all participants (DG and TD participants), only for the DG, and then only for the TD group. In relation to the agreement between parent and teacher ratings on all the BRIEF-2 scales with the whole sample, correlations between parent and teacher ratings were moderate to high and reached a statistically significant level on all the scales and indices (see Table 2). In the DG (using a Bonferroni correction p value of .003), correlations between parent and teacher ratings were moderate and reached a statistically significant level for Inhibition ($r = .388$, $p < .001$), Working Memory ($r = .435$, $p < .001$), Organization of Materials ($r = .397$, $p < .001$), BRI ($r = .435$, $p < .001$), and CRI ($r = .306$, $p < .003$), whereas in the TD group, parent and teacher ratings were moderate and statistically significant only for Working Memory ($r = .340$, $p < .001$) and Organization of Material ($r = .300$, $p < .003$).

CID was used as the second method of analysis to examine disagreements between parents and teachers. The MANCOVA showed significant main effects by group, Wilks's Lambda (Λ) = .751, $F(13, 143) = 2.148$, $p < .001$, $\eta_p^2 = .24$, with a medium effect size. As shown in Figure 1, in both DG and TD group, teachers reported more difficulties than parents did on the majority of scales and indices. ANCOVAs showed that teachers significantly rated children and adolescents in the DG as having more difficulties than their peers in the TD group on Working Memory, $F(13, 143) = 16.235$, $p < .001$, $\eta_p^2 = .09$, and on the CRI, $F(13, 143) = 9.178$, $p < .001$, $\eta_p^2 = .05$, with small effect sizes. Teachers also reported more difficulties of participants in the DG than parents did in other scales, such as Shift, Initiate, Planning–Organization, and GEC (but not at statistically significant levels).

With our third method of analysis, we examined agreements and disagreements between raters by computing the percentage of children in the DG who obtained scores that exceeded clinical cutoff ranges on the BRIEF-2. As indicated in Table 3, the vast majority of parents and teachers of youth with dyslexia reported that behaviors related to behavioral and emotional regulation were not severe enough to fall within clinically significant ranges. Specifically, 100% of parents and teachers agreed that participants did not meet clinical cutoff scores for BRI and ERI, and only a small percentage of participants (n = 1–10) were judged to exceed clinical cutoff scores for BRI and ERI subscales (i.e., Inhibit, Self-Monitor, Shift, Emotional Control)—all of which were reflected in teachers' ratings.

With regard to behavior related to cognitive regulation as defined by the BRIEF-2, approximately 40% of participants in the DG were identified as clinically impaired in task monitoring (19.2% by parent only, 12.8% by teacher only, and 6.4% by both parent and teacher), in organization of materials (2.6% by parent only, 21.8% by teacher only, and 12.8% by both parent and teacher), or in GEC (6.1% by parent only, 28.2% by teacher only, and 3.8% by both parent and teacher). The percentage of students in the DG with clinically elevated scores was much higher for the other cognitive scales: 62.8% were identified as clinically impaired in initiate (28.2% by both parent and teacher), 82% were identified as clinically impaired in Working Memory (44.9% by both parent and teacher), 73.1% were impaired in Planning–Organization (35.9% by both parent and teacher), and 73.1% in CRI (38.5% by both parent and teacher). In nearly all of the BRIEF-2 scales, however, teachers reported more children and adolescents with dyslexia clinically impaired than parents did. This difference was statistically significant in the domains of Shift, Initiate, Working Memory, Planning–Organization, Organization of Materials, CRI, and GEC.

Table 2. Pearson's Correlation Coefficients and *T*-Score Means and Standard Deviations on All Scales and Indices of the BRIEF-2.

Scales and Indices of the BRIEF-2		DG ($n = 78$)		TD group ($n = 82$)		Parent statistics			Teacher statistics		
		Parent	Teacher	Parent	Teacher						
	r	$M \pm SD$	$M \pm SD$	$M \pm SD$	$M \pm SD$	$F(1, 155)$	p	η_p^2	$F(1, 155)$	p	η_p^2
Inhibit[a]	.42*	49.13 ± 6.10	50.03 ± 5.31	44.95 ± 3.87	47.37 ± 5.18	25.699	.001	.14	n.s.	n.s.	n.s.
Self-Monitor[a]	.44*	46.50 ± 4.99	49.06 ± 4.79	43.95 ± 3.65	45.83 ± 5.28	13.169	.001	.07	15.595	.001	.09
Shift[b]	.37*	48.54 ± 5.64	56.36 ± 9.28	46.38 ± 5.92	49.56 ± 6.79	n.s.	n.s.	n.s.	19.050	.001	.10
Emotional Control[b]	.42*	48.28 ± 7.16	51.85 ± 6.13	44.01 ± 5.99	48.41 ± 4	11.414	.001	.07	11.754	.001	.07
Initiate[c]	.50*	56.62 ± 9.99	62.23 ± 11.05	47.98 ± 8.15	47.90 ± 6.78	38.957	.001	.20	90.837	.001	.37
Working Memory[c]	.72*	62.18 ± 9.35	70.23 ± 13.11	46.95 ± 6.48	47.51 ± 7.13	125.052	.001	.44	153.411	.001	.49
Planning–Organization[c]	.62*	59.49 ± 8.67	64.64 ± 9.24	47.13 ± 5.68	47.35 ± 6.15	105.278	.001	.40	159.022	.001	.50
Task Monitoring[c]	.47*	56.36 ± 9.11	57.10 ± 9.27	45.68 ± 7.25	44.46 ± 9.14	61.310	.001	.28	54.008	.001	.25
Organization of Materials[c]	.42*	53.05 ± 10.95	57.10 ± 11.20	45.70 ± 7.11	47.88 ± 7.76	16.700	.001	.11	31.970	.001	.17
Behavioral Regulation Index	.45*	48.03 ± 5.96	52.90 ± 5.21	44.23 ± 5.14	48.20 ± 5.46	14.722	.001	.08	22.765	.001	.12
Emotional Regulation Index	.46*	48.13 ± 5.97	51.64 ± 4.67	44.29 ± 5.11	47.23 ± 5.38	14.157	.001	.08	12.801	.001	.07
Cognitive Regulation Index	.64*	59.00 ± 8.48	65.26 ± 11.16	46.16 ± 6.18	46.90 ± 6.60	94.482	.001	.40	137.946	.001	.47
Global executive composite	.60*	55.03 ± 7.19	61.46 ± 8.93	44.50 ± 7.21	47.22 ± 6.38	76.805	.001	.33	108.748	.001	.41

Note. Correlations by subgroup (DG and TD) are summarized in the "Results" section. BRIEF-2 = Behavior Rating Inventory of Executive Function, Second Edition; DG = dyslexia group; TD = typically developing; n.s. = not statistically significant.

[a]This domain is a subscale of the Behavioral Regulation Index. [b]This domain is a subscale of the Emotional Regulation Index. [c]This domain is a subscale of the Cognitive Regulation Index.

*$p < .001$ reflecting data across the full sample (DG and TD group).

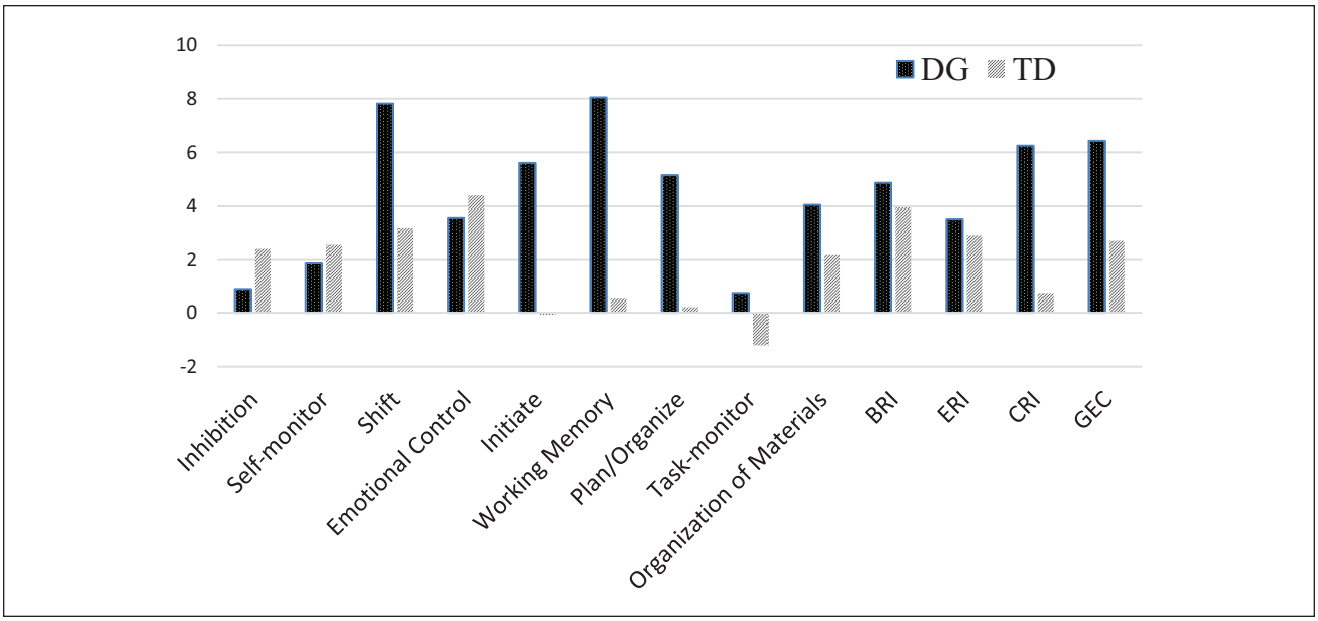

Figure 1. Mean CID scores for all scales and indices of the BRIEF-2.
Note. CID scores were calculated by subtracting parents' BRIEF-2 *T*-scores from teachers' *T*-scores. Positive scores indicate that teachers reported more difficulties than parents did, and negative scores indicate the opposite. CID = cross-informant disagreement; BRIEF-2 = Behavior Rating Inventory of Executive Function, Second Edition; DG = dyslexia group; TD = typically developing; BRI = Behavioral Regulation Index; ERI = Emotional Regulation Index; CRI = Cognitive Regulation Index; GEC = global executive composite.

Table 3. Among Participants With Dyslexia, Percentage of Parent and Teacher Ratings Above a Clinically Elevated *T*-Score.

Scales and Indices of the BRIEF-2	Parent	Teacher	Parent + teacher	Neither parents nor teachers	Parents versus teachers	
	% (*n*) $T > 65$	% (*n*) $T > 65$	% (*n*) $T > 65$	% (*n*) $T > 65$	$\chi_{(1)}^2$	*p*
Inhibit	(0)	2.6 (2)	(0)	97.4 (76)	n.s.	n.s.
Self-Monitor	(0)	1.3 (1)	(0)	98.7 (77)	n.s.	n.s.
Shift	(0)	12.8 (10)	(0)	87.2 (68)	11.282	.001
Emotional Control	(0)	2.6 (2)	(0)	97.4 (76)	n.s.	n.s.
Initiate	9.0 (7)	25.6 (20)	28.2 (22)	37.2 (29)	7.782	.01
Working Memory	3.8 (3)	33.3 (26)	44.9 (35)	17.9 (14)	30.307	.001
Planning–Organization	10.3 (8)	26.9 (21)	35.9 (28)	26.9 (21)	8.417	.01
Task Monitoring	19.2 (15)	12.8 (10)	6.4 (5)	61.5 (48)	n.s.	n.s.
Organization of Materials	2.6 (2)	21.8 (17)	12.8 (10)	62.8 (49)	11.572	.001
Behavioral Regulation Index	(0)	(0)	(0)	100 (78)		
Emotional Regulation Index	(0)	(0)	(0)	100 (78)		
Cognitive Regulation Index	6.4 (4)	28.2 (22)	38.5 (30)	28.2 (22)	15.911	.001
Global executive composite	6.1 (5)	28.2 (22)	3.8 (3)	61.5 (48)	12.947	.001

Note. Only data from the DG are reported because very few students in the TD group were reported to have clinically elevated scores. Specifically, only two students from the TD group were reported to have a clinically elevated score within the BRIEF-2 Index scales—both reflected difficulty only in the Cognitive Regulation Index, and clinically elevated scores were reported by teachers but not by parents. For the Behavioral Regulation and Emotional Regulation indices, the chi-square cannot be calculated because the value of zero cases is a constant. n.s. = not statistically significant; DG = dyslexia group; TD = typically developing; BRIEF-2 = Behavior Rating Inventory of Executive Function, Second Edition.

Discussion

To our knowledge, this study is the first to investigate parent and teacher perceptions of EF skills of children and adolescents with dyslexia, compared with TD peers, using a commonly used rating scale designed to assess perceptions about different empirically established domains (i.e., cognitive, behavioral, and emotional) of EF. By examining these

three domains of EF in two differing contexts (i.e., home and school) that involve different EF demands, this allows for a more comprehensive assessment and an ability to examine possible agreements and disagreements between parents and teachers.

Parent and Teacher Reports of EF

The first research question of the study was to examine whether there were differences in how students with dyslexia were rated (by parents and teachers) on EF behaviors compared with peers without dyslexia. We found that children and adolescents with dyslexia were rated by parents and teachers as having significantly worse EF than TD controls on nearly every subscale and index of the BRIEF-2. Thus, both parent and teacher ratings reflected larger differences in impairment for those in the DG versus TD group on cognitive domain (e.g., Initiation, Working Memory, Planning–Organization, Task Monitoring, Organization of Materials, and CRI), behavioral domain (e.g., Self-Monitor, BRI), and emotional domain (e.g., Emotional Control, ERI), and on GEC. However, parents reported more Inhibition difficulties (behavioral domain) with DG participants, whereas teachers reported more difficulties in Shift (emotional domain) among students in the DG. Although our findings from parents were consistent with the small number of past studies that examined EF of children and adolescents with dyslexia (Gioia et al., 2002b; Locascio et al., 2010; Schöfl et al., 2014), we also identified additional differences in teacher-reported EF concerns between the DG and TD groups. These findings help to provide new insights into patterns of teacher-reported EF concerns in children and adolescents with dyslexia.

Agreements and Disagreements Among Parent and Teacher Ratings of EF

With respect to our second research question—to evaluate multi-informant agreements and disagreements among parent and teacher raters of EF—there were important indicators of both agreement and disagreement. In relation to agreements between parent and teacher ratings, correlation coefficients across all participants were moderate to high and statistically significant on all BRIEF-2 scales and indices. These results are consistent with those reported with a normative sample by Gioia et al. (2015, 2017), possibly because BRIEF-2 parent and teacher forms have 85% of the items in common. However, within each group, the correlations were moderate only in a few subscales. No past studies have evaluated the relationship of ratings between parents and teachers for students with dyslexia, so this initial study suggests that with this subpopulation of students, we may not see as high of an agreement level between parents and teachers compared with TD samples.

We also found agreements between parents and teachers about clinically elevated scores. There was strong agreement among parents and teachers that students in the TD group did not exhibit clinically elevated behavior. Similarly, parents and teachers had high levels of agreement to suggest that most participants with dyslexia did not have clinically elevated EF difficulties related to behavioral and emotional regulation. However, we also found notable disagreements between parents and teachers. Results from CID analyses showed that in both the DG and TD group, teachers reported more difficulties than parents did on some cognitive (e.g., Initiate, Working Memory, Planning–Organization) and emotional (e.g., Shift) domains and indices (e.g., CRI and GEC), especially in working memory and in the CRI. Furthermore, we found notable disagreements between parents and teachers in the cognitive domain, and found that teachers more often reported clinically elevated difficulties. To illustrate, 25% to 33% of the teachers perceived students to have clinically elevated scores on the Initiate, Working Memory, Planning–Organization, CRI, and GEC domains, whereas none of the parents of those students rated their behavior as clinically elevated in those domains. In the behavioral (e.g., Inhibit, Self-Monitor) and in the emotional (e.g., Shift, Emotional Control) domains, teachers judged a small percentage of participants (n = 1–10) to exceed clinical cutoff scores. In summary, teachers reported more variety and severity of EF impairments in youth with dyslexia than parents did.

Oftentimes, informant disagreements are explained by measurement error or as an informant bias (see De Los Reyes et al., 2013). That is, informants' ratings are influenced by personal biases, prior experiences, and/or beliefs (Collett et al., 2003a, 2003b). However, CID may reflect true setting-related (e.g., home and school) differences and/or differences in an informant's knowledge and experiences (Achenbach, 2011, 2017; De Los Reyes & Kazdin, 2004, 2005). Thus, disagreements between reporters could be the result of cross-situational differences in children's or adolescents' behavior, or differences in raters' perceptions and expectations. In this context, our results may suggest that teachers' training and familiarity with age-appropriate behavior enables them to more readily recognize difficulties within the EF domain, and they may have more opportunities to make age-appropriate comparisons. In addition, the school environment is likely to be more structured and less flexible than the home environment. In school, children and adolescents are required to regulate and monitor their behavior, plan and organize for current and future tasks, and use working memory to complete tasks and solve problems. By contrast, the home environment can be more accommodating and tolerant with EF impairments.

Implications for Practice and Research

There are several implications to consider based on our findings. First, there are now a few studies showing that parents or teachers perceive a relatively large subset of students with reading disabilities to have clinically elevated impairments in EF, particularly in the context of cognitive regulation behaviors such as working memory, planning, and organizing. For parents, educators, and clinicians, this emerging evidence suggests that assessment for students with dyslexia might also include an assessment of EF. By assessing EF with this population of students, their relative strengths and challenges may be better understood, thereby influencing how to best support students with reading disabilities. Indeed, comprehensive intervention planning for academic support often lacks critical components, such as conducting relevant behavioral or environmental assessments (e.g., Begeny et al., 2012; Best et al., 2011; Diamond, 2013), and this study provides further evidence that students with reading difficulties will likely benefit from assessment that extends beyond literacy skills.

In addition, our study is among the first to demonstrate that EF behaviors of students with dyslexia may be rated in meaningfully different ways between parents and teachers. As a potential implication for both researchers and practitioners, we suggest that both teachers and parents rate EF behaviors of students with reading disabilities to establish a more comprehensive understanding of a student's strengths, weaknesses, and (potentially) clinically elevated difficulties. Teachers may be better able to identify more and/or different EF difficulties in children and adolescents with dyslexia due to their normative experiences with approximately 20+ students each year, a more structured environment, and a range of educationally demanding activities with a given child. Parents of students with dyslexia may rate EF less severely and/or perceive different EF deficits because (a) the home environment or activities may not challenge their EF as much as school or (b) less structure in the home could make EF deficits less evident. Future research could also consider how differences in EF ratings between informants may have implications for how EF is conceptualized and defined.

When considering the need to have multiple informants and measures of EF for students with dyslexia, this suggests that intervention support plans may also need to be context specific. For example, when developing a comprehensive support plan, understanding the level of EF impairment at home *and* school should be useful in best supporting the students (Best et al., 2011; Zelazo et al., 2016). School-based supports may need to focus not only on reading intervention but also on assisting the student with working memory, initiating literacy tasks, and keeping relevant materials organized. In many cases, the same student will also benefit from home-based support systems; however, EF difficulties at home may be different from those observed in school. If so, those specific EF difficulties observed in the home setting (e.g., task monitoring) may be a specific focus during intervention planning.

Limitations and Other Future Research Directions

Although relevant implications can be drawn from this study and how it extends similar research, study limitations and future research directions are important to elucidate. First, the present study included a relatively comprehensive assessment of participants' reading skills, but it did not assess all important aspects of literacy (e.g., reading comprehension or writing skills). Future research in this area should consider the depth and breadth of literacy assessment that is necessary to determine the presence of a reading disability. Similarly, although rating scales continue to be advocated for as an assessment of EF that supports treatment planning and evaluation (e.g., Isquith et al., 2014), and although a goal of our study was to expand the existing research by using rating scales of EF across multiple informants, our study did not use performance-based measures or direct observations of EF. It is therefore possible that additional evaluation of participants' EF could have impacted data interpretation. With this in mind, future studies might seek to expand on past studies by evaluating EF with performance measures, self-report measures (i.e., from those with dyslexia), and ratings from different informants (e.g., parents and multiple types of teachers, such as classroom teachers and special education teachers). Finally, the present study did not evaluate the potential impacts of teachers' training in areas such as reading, dyslexia, or special education. Empirical data about Spanish teachers' knowledge about dyslexia are quite scarce (Echegaray-Bengoa & Soriano-Ferrer, 2016; Soriano-Ferrer et al., 2016), so future research should consider knowledge and training in the context of teacher ratings.

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